

Protocol for Heat-Inactivation of Serum and Plasma Samples (June 2015)

I. Introduction

Serum and plasma samples must be heat-inactivated to destroy complement prior to performing neutralizing antibody assays. Complement is comprised of a set of approximately 20 blood proteins that mediate a variety of functions in the body [1]. One of these functions is to kill microbes by complement-mediated lysis. Human complement does not lyse human cells or HIV-1 (rabbit and rodent complement will) because both contain regulatory proteins on their surface (e.g., CD35, CD46, CD55, CD59) that inhibit the terminal complement pathway and formation of the membrane attack complex [2]. The virus obtains these regulatory proteins as it buds from the plasma membrane of infected cells [3, 4]. Nonetheless, human complement will deposit on the virus surface in the form of activated fragments of complement component C3 (e.g., C3b and C3d), which are part of the early activation pathway that is not affected by the regulatory proteins mentioned above. HIV-1 can activate the complement system through specific sites on gp120 and gp41 and the activation is further facilitated by antibodies to both envelope glycoproteins [3].

Complement activation by antibody is mediated by the Fc region of the antibody molecule. Deposition of activated complement fragments on the virus surface can target the virus to complement receptors on several CD4⁺ T cell lines used for neutralization assays (MT-2, CEMx174, M7-Luc). The most common complement receptor on these cells that the virus uses is CR2 (CD21) [5-7]. An important consequence of complement deposition on the virus is infection-enhancement. Infection-enhancement is most evident in the presence of gp120-specific and gp41-specific antibodies and may mask the activity of neutralizing antibodies [4]. It is not clear that infection-enhancing antibodies detected in this assay are relevant to natural target cells *in vivo* [4, 8, 9]. Enhancement may be measured in independent assays if desired [8, 9].

Complement activation is not known to be an issue for PBMC assays because normal CD4⁺ T cells do not express a sufficient level of complement receptors. Both serum and plasma contain complement. The complement system can be destroyed by heat-inactivation at 56°C.

II. Definitions

ACD: acid citrate dextrose

EDTA: ethylenediaminetetraacetic acid

ID: identification

III. Reagents and Materials

Recommended vendors are listed. Unless otherwise specified, products of equal or better quality than the recommended ones can be used whenever necessary.

Cryogenic vials, sterile screw cap, frosted label

Vendor: Sarstedt Brand Products

Sterile gauze pads

Vendor: VWR Scientific

Disposable pipettes, sterile, individually wrapped

Vendor: Falcon/VWR

1 ml pipettes

5 ml pipettes

IV. Instrumentation

Recommended manufacturers are listed. Unless otherwise specified, equipment of equal or better quality than the recommended ones can be used whenever necessary.

Biological Safety Cabinet

Manufacturer: Baker Co.

Water bath

Manufacturer: Precision Scientific

Centrifuge and Microcentrifuge

Manufacturer: Eppendorf

Maximum rotational speed = 14,000 rpm

18 place standard rotor F-45-18-11 for 1.5 ml microcentrifuge tubes

Pipettor

Manufacturer: Drummond Scientific Co.

PipetteAid XP

V. Specimens

Serum and plasma

Specimens can be either serum or plasma and are stored in sterile polypropylene cryovials. Serum is obtained from coagulated blood, which is collected in a red-top vacutainer tube. Plasma is obtained from anti-coagulated blood, where clotting is prevented by adding either heparin, EDTA, or ACD to the tubes prior to blood collection. Collection tubes for anti-coagulated blood can be obtained commercially and are color-coded green (heparin), yellow (ACD), and purple (EDTA).

Serum is preferred for neutralizing antibody assays. Anticoagulants in plasma are problematic, especially when heparin is used (some forms of heparin have potent and strain-specific antiviral activity), since they are all toxic to cells at plasma dilutions lower than 1:60.

VI. Protocol

1. Heat-Inactivation Procedure

1.1 Thaw samples at room temperature. This may be accomplished in a short period of time by placing the tubes in a water bath at ambient temperature.

1.2 Gently mix the samples after thawing and centrifuge briefly (pulse for approximately 5 seconds) in a microcentrifuge to assure that no sample remains adhered to the inside cap or sides of the tube.

NOTE 1: Proteins will separate from serum and settle on the bottom of the tube after a freeze-thaw cycle. It is important to mix the samples to redistribute the proteins evenly throughout the sample prior to heat-inactivation.

NOTE 2: If aliquoting samples for heat-inactivation, use 1ml or 2ml microcentrifuge tubes for sample volumes between 0.5ml and 1.0ml, respectively. Use 500µl microcentrifuge tubes for aliquoting samples with volumes less than 500µl. This will ensure that the sample will be covered by the liquid in the water bath, but not contacting the cap.

1.3 Place the tubes in a 56°C water bath, allowing the water level to reach the top of the sample volume but not touching the rim of the cap of the tube. Incubate for 30 minutes total (for human, non-human primate, rabbit and guinea pig) or 15 minutes total (for mice).

NOTE 3: The water bath should be turned on at least 1 hour before use to assure the temperature has stabilized.

NOTE 4: Caution! Temperatures above 58°C will turn serum and plasma into the solid phase – a process that cannot be reversed and essentially destroys the sample permanently.

1.4 Remove the tubes from the water bath and wipe the outside of the tubes with a clean gauze pad.

1.5 Gently mix the samples to collect condensation on the inside surface and pulse centrifuge to ensure that no sample remain adherent to the cap or sides of the tube.

1.6 Mark each tube with a triangle and the amount of time the samples were heat inactivated (e.g., 10') on the cryogenic tube label to indicate the heat inactivation process has been completed.

1.7 Store the samples at 4°C when assays are to be performed within 2 weeks. Store the tubes at -20°C when assays are delayed for >2 weeks.

1.8 Log the date, length of heat inactivation, temperature, study name, and number of samples processed in a heat inactivation log.

VII. References

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